3.0 AASHTO Controlling Design Criteria

3.1 Introduction

The existing features of I-17 between SR 101L and the Black Canyon City TI (MP 214.5 to MP 244.5) were analyzed using the American Association of State Highway and Transportation Officials (AASHTO) Controlling Design Criteria outlined in *A Policy on Geometric Design of Highways and Streets* (1990 edition), also known as the AASHTO Green Book.

This section will describe the non-conforming AASHTO design elements of the existing highway which will be upgraded as part of the project and others for which design exceptions will be requested. The recommended alternative will be used to make this determination. A complete analysis is available in the *Initial AASHTO Controlling Design Criteria Report, I-17: SR 101L TI to Black Canyon City TI and Table Mesa TI*, TRACS No. 17 MA 215 H5162 01L, October 2000. Horizontal and vertical data summaries are provided in Appendix A.

3.2 Lane and Shoulder Widths

The existing lane and shoulder widths in the study area meet AASHTO recommendations. All lane and shoulder widths used in developing design concept alternatives conform to current design recommendations.

3.3 Vertical Alignment and Stopping Sight Distance

The existing vertical stopping sight distance is less than the AASHTO-recommended 650 feet at the following locations. Because the added lanes will match the existing profile grade, these locations will require design exceptions.

- Northbound MP 232.00 to 232.20 – 16' less than recommended
- Northbound MP 232.80 to 233.00 – 26' less than recommended
- Northbound MP 237.20 to 237.50 – 57' less than recommended
- Northbound MP 238.20 to 238.30 – 12' less than recommended
- Northbound MP 240.00 to 240.40 – 33' less than recommended
- Northbound MP 242.20 to 242.30 – 19' less than recommended
- Southbound MP 239.70 to 239.60 – 122' less than recommended
- Southbound MP 238.70 to 238.60 – 141' less than recommended
- Southbound MP 236.00 to 235.70 – 34' less than recommended
- Southbound MP 233.70 to 233.50 – 14' less than recommended
- Southbound MP 232.20 to 232.00 – 15' less than recommended

The existing vertical stopping sight distance is less than the AASHTO-recommended 475 feet at the following locations at the Table Mesa TI. The vertical alignment for the recommended TI alternative at this location will conform to current design standards; therefore, no design exceptions will be required.

- Table Mesa Road VPI Sta. 15+00.00 – 86' less than recommended
- Table Mesa Road VPI Sta. 22+50.00 – 242' less than recommended
- Ramp 236G – NB Entrance Ramp VPI Sta. 1+00.00 – 216' less than recommended
- Ramp 236G – NB Entrance Ramp VPI Sta. 5+00.00 – 40' less than recommended

3.4 Horizontal Alignment and Stopping Sight Distance

The existing horizontal alignment contains 20 horizontal curves in the northbound direction and 19 in the southbound direction. A listing of the horizontal curve analysis is included in Appendix A.

The existing horizontal curve superelevation is less than the AASHTO-recommended minimum at the following locations. Although the added lanes will match the existing horizontal alignment, areas of deficient superelevation will be corrected as part of the widening of I-17. Complete pavement reconstruction will be completed to modify superelevation to current design standards. Therefore, no design exceptions will be required for horizontal curve superelevation.

- Northbound MP 227.10 to 227.50 – 0.007 '/ft less than the recommended 0.022 '/ft
- Northbound MP 233.30 to 233.40 – 0.020 '/ft less than the recommended 0.043 '/ft
- Northbound MP 233.80 to 234.00 – 0.001 '/ft less than the recommended 0.055 '/ft
- Northbound MP 234.20 to 234.40 – 0.020 '/ft less than the recommended 0.043 '/ft
- Northbound MP 234.70 to 234.90 – 0.008 '/ft less than the recommended 0.023 '/ft
- Northbound MP 235.20 to 235.30 – 0.020 '/ft less than the recommended 0.043 '/ft
- Northbound MP 237.20 to 237.60 – 0.015 '/ft less than the recommended 0.030 '/ft
- Northbound MP 238.50 to 239.50 – 0.008 '/ft less than the recommended 0.023 '/ft
- Northbound MP 239.60 to 240.40 – 0.015 '/ft less than the recommended 0.030 '/ft
- Northbound MP 242.10 to 242.50 – 0.015 '/ft less than the recommended 0.030 '/ft
- Northbound MP 244.30 to 244.70 – 0.041 '/ft less than the recommended 0.056 '/ft
- Southbound MP 244.70 to 244.30 – 0.039 '/ft less than the recommended 0.054 '/ft
- Southbound MP 240.80 to 240.60 – 0.001 '/ft less than the recommended 0.055 '/ft
- Southbound MP 240.00 to 239.70 – 0.020 '/ft less than the recommended 0.043 '/ft
- Southbound MP 238.40 to 237.90 – 0.021 '/ft less than the recommended 0.036 '/ft

- Southbound MP 237.80 to 237.70 – 0.015 '/ft less than the recommended 0.030 '/ft
- Southbound MP 237.40 to 237.10 – 0.020 '/ft less than the recommended 0.043 '/ft
- Southbound MP 237.00 to 236.90 – 0.015 '/ft less than the recommended 0.030 '/ft
- Southbound MP 236.80 to 236.70 – 0.015 '/ft less than the recommended 0.030 '/ft
- Southbound MP 227.50 to 227.20 – 0.008 '/ft less than the recommended 0.023 '/ft

The existing horizontal curve superelevation is less than the AASHTO-recommended minimum at the following locations at the Table Mesa TI. The superelevation for the recommended TI alternative at this location will conform to current design standards; therefore, no design exceptions will be required.

- Ramp 236J, Table Mesa TI – SB Entrance Ramp HPI Station 3+33.48 – 0.052 '/ft less than the recommended 0.092 '/ft
- Ramp 236A, Table Mesa TI – NB Exit Ramp HPI Station 8+40.00 – 0.057 '/ft less than the recommended 0.072 '/ft

The existing horizontal curvature exceeds the AASHTO-recommended maximums at the following locations. The horizontal alignment for the recommended TI alternative at this location will conform to current design standards; therefore, no design exceptions will be required.

- Table Mesa Road HPI Station 11+22.50 – 7°45' greater than the recommended 8°15'.
- Ramp 236D, Table Mesa TI – SB Exit Ramp HPI Sta. 6+99.85 – 1°57' more than the recommended 36°15'.

3.5 Design Speed

The route's classification, use, and terrain determine the appropriate design speed to be used to evaluate the existing and proposed roadway. Because the existing facility traverses urban and rural surroundings on level and rolling terrain, the AASHTO Green Book and ADOT Roadway Design Guidelines recommend design speeds of 50 to 70 mph as detailed below.

From MP 214.5 to MP 218.8, the AASHTO-recommended minimum design speed of the highway is 50 mph (level terrain, urban). Posted speeds in this section are 55 mph from MP 214.5 to MP 216.4 and 65 mph from MP 216.4 to MP 218.8.

From MP 218.8 to MP 224.0, the AASHTO-recommended minimum design speed of the highway is 70 mph (level terrain, rural). The posted speed in this section is 75 mph.

From MP 224.0 to MP 244.5, the AASHTO-recommended minimum design speed of the highway is 60 mph (rolling terrain, rural). Posted speeds in this section are 75 mph from MP 224.0 to MP 243.8 and 65 mph from MP 243.8 to MP 244.5.

Because posted speeds are higher than recommended design speeds, a design speed of 75 mph was used for developing design concept alternatives and is recommended for final design.

3.6 Grades

Because the existing profile will be matched for the recommended alternative, design exceptions will be required for those existing grades in excess of AASHTO guideline recommendations. The existing gradient is greater than the AASHTO-recommended 4% maximum at the following locations.

- Northbound MP 237.4 to 238.3 – 1.000% greater than recommended
- Southbound MP 238.4 to 238.7 – 1.167% greater than recommended

3.7 Cross Slopes

Existing cross slopes of 1.5% to 2% conform to current design recommendations.

3.8 Vertical Clearance

AASHTO recommends that existing structures provide 16 feet of clearance over the entire roadway width. The existing vertical clearance is less than the AASHTO-recommended 16-foot minimum at the following locations:

- Northbound MP 217.10 Pinnacle Peak Rd TI UP (#00821) – 15' 11"
- Southbound MP 223.99 Carefree Highway TI UP (#00824) – 15' 10"
- Northbound MP 235.94 Table Mesa Rd TI UP (#01295) – 15' 11"

The Carefree Highway TI will be reconstructed as a separate project that will likely precede construction of any elements of this project. The Table Mesa Road TI structures and Pinnacle Peak TI structure are included as part of this project. Therefore, no design exceptions for vertical clearance will be required.

3.9 Bridge Structures

The existing bridge width is less than the AASHTO-recommended 38 feet minimum at the following locations. No design exceptions will be required since these bridges will be widened to accommodate the recommended alternative.

- MP 239.20 Little Squaw Creek Br NB (#00968) – 5.5' less than recommended
- MP 238.60 Moores Gulch Bridge SB (#00339) – 6.2' less than recommended
- MP 239.55 Little Squaw Creek Br SB (#00340) – 6.2' less than recommended

The existing bridge rail geometry does not meet the recommended AASHTO criteria at the following locations. Bridge rail will be upgraded or replaced with this project on all bridges listed below except Pinnacle Peak TI (replaced during recent reconstruction), Carefree Highway TI (separate project), Pioneer TI, and Mud Springs UP; design exceptions will be required for the Pioneer and Mud Springs bridges.

- MP 217.10 Pinnacle Peak TI UP (#00821)
- MP 218.01 Happy Valley TI UP (#00822)

- MP 219.11 Skunk Creek Br. EFR (#01078)
- MP 219.11 Skunk Creek Br. WFR (#01079)
- MP 223.99 Carefree Highway TI UP (#00824)
- MP 225.50 Pioneer TI UP (#01289)
- MP 235.94 Table Mesa TI UP SB (#01294)
- MP 235.94 Table Mesa TI UP NB (#01295)
- MP 242.98 Mud Springs UP (#00863)

The existing bridge rail structure does not meet the recommended AASHTO criteria at the following locations. Bridge rail on all bridges listed below will be upgraded or replaced with this project except Pinnacle Peak TI (replaced during recent reconstruction), Carefree Highway TI (separate project), and Mud Springs UP; a design exception will be required for the Mud Springs bridge.

- MP 217.10 Pinnacle Peak TI UP (#00821)
- MP 218.01 Happy Valley TI UP (#00822)
- MP 219.11 Skunk Creek Br. EFR (#01078)
- MP 219.11 Skunk Creek Br. WFR (#01079)
- MP 223.99 Carefree Highway TI UP (#00824)
- MP 226.95 Deadman Wash Br. NB (#00905)
- MP 242.98 Mud Springs UP (#00863)

The AASHTO Green Book recommends a bridge structure capacity of HS 20.0. The existing bridge structural capacity is less than AASHTO recommendations at the following locations. Since many of these bridges will need to be widened or modified to accommodate the future I-17 widened section, each bridge will need to be evaluated during final design to determine if replacement is necessary or if design exceptions for bridge structure capacity should be pursued at that time. Therefore design exceptions may be required for structural inventory capacity deficiencies on those existing bridges for which major structural modifications are not included in this project.

- MP 219.11 Skunk Creek Br. EFR (#01078) – HS 14.4, to be replaced
- MP 219.11 Skunk Creek Br. WFR (#01079) – HS 14.4, to be replaced
- MP 231.40 New River Br. NB (#01290) – HS 16.7, design exception may be required
- MP 239.20 Little Squaw Creek Br. NB (#00968) – HS 19.4, design exception may be required

- MP 242.10 Rock Springs TI UP NB (#00969) – HS 18.9, design exception may be required
- MP 219.11 Skunk Creek Br. SB (#00285) – HS 15, design exception may be required
- MP 226.95 Deadman Wash Br. SB (#00304) – HS 14.4, design exception may be required
- MP 231.40 New River Br. SB (#01291) – HS 14.4, design exception may be required
- MP 238.60 Moores Gulch Br. SB (#00339) – HS 17.2, design exception may be required
- MP 239.55 Little Squaw Creek Br. SB (#00340) – HS 17.2, design exception may be required
- MP 242.25 Rock Springs TI UP SB (#00970) – HS 18.9, design exception may be required